



# 150W DC-DC Half-Brick Regulated Single Output Converter

# MHB150 series



## ■ Features :

- Half-brick size (2.28"X2.4"X0.5") with industry standard pin out
- 2:1 wide input range
- Protections: Short circuit / Over current / Over voltage / Over temperature
- High efficiency up to 89%
- 1500VDC I/O isolation
- Built-in remote ON/OFF control
- Built-in remote sense function
- Trimming output  $\pm 10\%$
- Five-sided shield metal case
- Optional heat sinks for extended operating temperature
- Output 2.5V/3.3V/15V available
- Approvals: UL / CUL / CE
- 3 years warranty



## SPECIFICATION

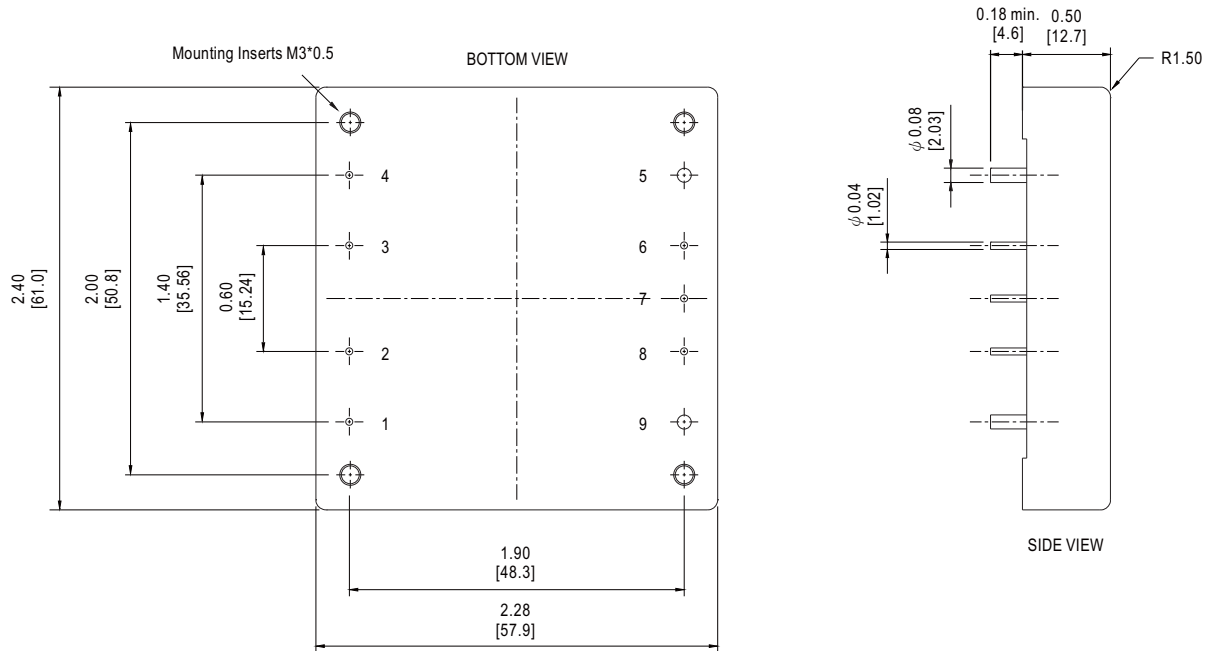
| MODEL                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | MHB150-48S05 | MHB150-48S12                                                                                                                      | MHB150-48S24 |      |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------|--------------|------|
| OUTPUT                          | DC VOLTAGE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 5V           | 12V                                                                                                                               | 24V          |      |
|                                 | CURRENT RANGE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0 ~ 30A      | 0 ~ 12.5A                                                                                                                         | 0 ~ 6.25A    |      |
|                                 | RATED POWER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 150W         |                                                                                                                                   |              |      |
|                                 | RIPPLE & NOISE (max.) Note.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 100mVp-p     | 150mVp-p                                                                                                                          | 240mVp-p     |      |
|                                 | VOLTAGE ACCURACY Note.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | ±1.0%        |                                                                                                                                   |              |      |
|                                 | LINE REGULATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ±0.2%        |                                                                                                                                   |              |      |
|                                 | LOAD REGULATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ±0.2%        |                                                                                                                                   |              |      |
|                                 | SWITCHING FREQUENCY (Typ.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 500KHz       |                                                                                                                                   |              |      |
|                                 | EXTERNAL TRIM ADJ. RANGE (Typ.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ±10%         |                                                                                                                                   |              |      |
| EXTERNAL CAPACITIVE LOAD (max.) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 30000uF      | 12500uF                                                                                                                           | 6250uF       |      |
| INPUT                           | RATED DC INPUT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |              | 48VDC                                                                                                                             |              |      |
|                                 | VOLTAGE RANGE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              | 36 ~ 75VDC                                                                                                                        |              |      |
|                                 | SURGE VOLTAGE (100ms max.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              | 100VDC                                                                                                                            |              |      |
|                                 | UNDER VOLTAGE LOCKOUT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |              | Power up: 34VDC, Power down: 32.5VDC                                                                                              |              |      |
|                                 | EFFICIENCY (Typ.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              | 86%                                                                                                                               | 89%          | 89%  |
|                                 | DC CURRENT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | FULL LOAD    | 3.7A                                                                                                                              | 3.6A         | 3.6A |
|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | NO LOAD      | 25mA                                                                                                                              |              |      |
| FILTER                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Pi-network   |                                                                                                                                   |              |      |
| PROTECTION                      | OUTPUT OVER CURRENT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              | 110 ~ 140% rated output power<br>Protection type : Over current limiting, recovers automatically after fault condition is removed |              |      |
|                                 | OUTPUT OVER VOLTAGE (Typ.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              | 115 ~ 140% rated output voltage<br>Protection type : Output voltage clamp                                                         |              |      |
|                                 | OUTPUT SHORT CIRCUIT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              | Protection type : Can be continuous, recovers automatically after fault condition is removed                                      |              |      |
|                                 | OVER TEMPERATURE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              | 100℃ ±5℃ of case temperature                                                                                                      |              |      |
| FUNCTION OPERATING              | REMOTE CONTROL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |              | Please refer to "Remote ON/OFF Control" for details                                                                               |              |      |
|                                 | OUTPUT TRIMMING                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              | ±10%, Please refer to "External Output Trimming" for details                                                                      |              |      |
| ENVIRONMENT                     | WORKING TEMPERATURE (Typ.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              | -40 ~ +100℃ ; Thermal shutdown at 100℃ ±5℃ of case temperature (please refer to "Thermal Curve")                                  |              |      |
|                                 | WORKING HUMIDITY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              | 0% ~ 95% RH max.                                                                                                                  |              |      |
|                                 | STORAGE TEMP., HUMIDITY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              | -55 ~ +105℃, 0 ~ 95% RH                                                                                                           |              |      |
|                                 | TEMP. COEFFICIENT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              | ±0.03%/℃ (0~60℃ )                                                                                                                 |              |      |
| SAFETY & EMC (Note 4)           | SAFETY STANDARDS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              | UL60950-1, EAC TP TC 004 approved                                                                                                 |              |      |
|                                 | ISOLATION VOLTAGE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              | I/P-O/P:1500VDC, I/P-Case:1500VDC, O/P-Case:1500VDC                                                                               |              |      |
|                                 | ISOLATION RESISTANCE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              | I/P-O/P:100M Ohms / 500VDC / 25℃ / 70% RH                                                                                         |              |      |
|                                 | EMC EMISSION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              | Compliance to EN55032 (CISPR32) Class A with external components (please refer to "EMC Suggestion Circuit"), EAC TP TC 020        |              |      |
|                                 | EMC IMMUNITY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              | Compliance to EN61000-4-2,3,4,5,6,8; EN55024, light industry level, criteria A, EAC TP TC 020                                     |              |      |
| OTHERS                          | CASE MATERIAL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              | Aluminum                                                                                                                          |              |      |
|                                 | MTBF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              | 900K hrs typ. MIL-HDBK-217F (25℃)                                                                                                 |              |      |
|                                 | DIMENSION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              | 57.9*61*12.7mm (2.28**2.40**0.5") (L*W*H)                                                                                         |              |      |
|                                 | WEIGHT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              | 100g                                                                                                                              |              |      |
| NOTE                            | 1. All parameters NOT specially mentioned are measured at 48VDC input, rated load and 25℃ of ambient temperature.<br>2. Ripple & noise are measured at 20MHz of bandwidth by using a 12" twisted pair-wire terminated with a 1uf ceramic & 10uf tantalum capacitor across output.<br>3. The power supply need to connect "+Vout" to "+R.S" and "-Vout" to "-R.S".<br>4. The power supply is considered a component which will be installed into a final equipment. The final equipment must be re-confirmed that it still meets EMC directives. For guidance on how to perform these EMC tests, please refer to "EMI testing of component power supplies." |              |                                                                                                                                   |              |      |

## Mechanical Specification

Unit:inch[mm]

All Dimensions In Inches [mm]

Tolerance Inches: X.XX=  $\pm 0.02$  , X.XXX=  $\pm 0.010$ 

Millimeters: X.X=  $\pm 0.5$  , X.XX=  $\pm 0.25$ 


Pin No. Assignment

| Pin No. | Assignment | Pin No. | Assignment | Pin No. | Assignment |
|---------|------------|---------|------------|---------|------------|
| 1       | +Vin       | 4       | -Vin       | 7       | Trim       |
| 2       | R.C.       | 5       | -Vout      | 8       | +R.S.      |
| 3       | Case       | 6       | -R.S.      | 9       | +Vout      |

## Remote ON/OFF Control

The MHB150 series allow the user to switch the power ON and OFF electronically by their remote ON/OFF feature.

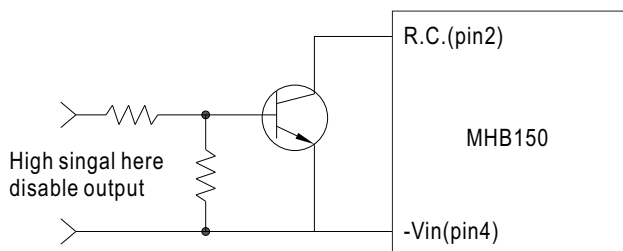
The MHB150 series are available with "Positive Logic" (standard) or "Negative Logic" (option).

Logic table

| Logic State(pin2)       | Positive logic         | Negative logic          |
|-------------------------|------------------------|-------------------------|
| Logic Low-Switch Closed | Power OFF(<0.8Vdc)     | Power ON(<0.8Vdc)       |
| Logic High-Switch Open  | Power ON(Open circuit) | Power OFF(Open circuit) |

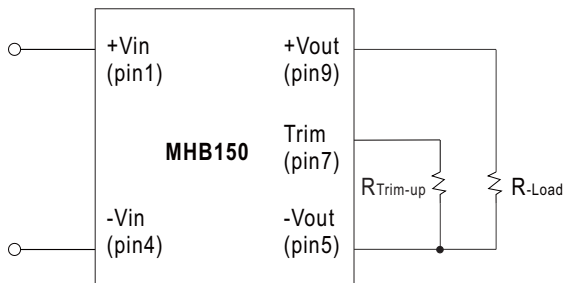
Note: 1.Logic compatibility : R.C.(pin2) ~ -Vin(pin4).

2.Suffix "N" to the model number with Negative logic remote ON/OFF.



Example control circuit(positive logic)

## External Output Trimming



**Figure 1 : Trim-up voltage setup**

The value of  $R_{Trim-up}$  defined as:

$$R_{Trim-up} = \frac{(R1-R2 \times (V_o - V_{o,nom}))}{(V_o - V_{o,nom})} (K\Omega)$$

Where:  $R_{Trim-up}$  is the external resistor in Kohm.

$V_{o,nom}$  is the nominal output voltage.

$V_o$  is the desired output voltage.

$R1$  and  $R2$  are inside the unit and list in Table 1

| Output Voltage(V) | R1 (Kohm) | R2 (Kohm) |
|-------------------|-----------|-----------|
| 5V                | 5.8       | 3.3       |
| 12V               | 18.945    | 4.636     |
| 24V               | 41.442    | 6.977     |

Table 1

For example, to Trim-up the output

voltage of 5.0V model (MHB150-48S05)

by 8% to 5.4V,  $R_{Trim-up}$  is calculated

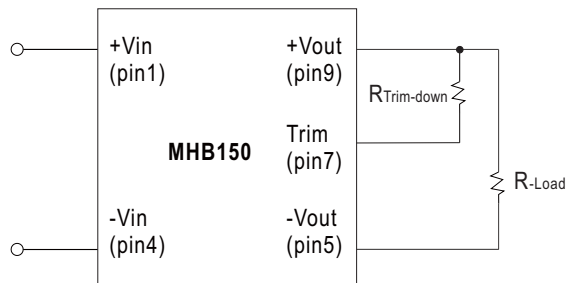
as follows:

$$V_o - V_{o,nom} = 5.4 - 5.0 = 0.4V$$

$$R1 = 5.8 \text{ Kohm}$$

$$R2 = 3.3 \text{ Kohm}$$

$$R_{Trim-up} = \frac{5.8 - 3.3 \times 0.4}{0.4} = 11.2 (K\Omega)$$



**Figure 2 : Trim-down voltage setup**

The value of  $R_{Trim-down}$  defined as:

$$R_{Trim-down} = \frac{(R1-R2 \times (V_o, nom - V_o))}{(V_o, nom - V_o)} (K\Omega)$$

Where:  $R_{Trim-down}$  is the external resistor in Kohm.

$V_{o,nom}$  is the nominal output voltage.

$V_o$  is the desired output voltage.

$R1$  and  $R2$  are inside the unit and list in Table 2.

| Output Voltage(V) | R1 (Kohm) | R2 (Kohm) |
|-------------------|-----------|-----------|
| 5V                | 5.8       | 5.32      |
| 12V               | 86.45     | 60.1      |
| 24V               | 430       | 120       |

Table 2

For example, to Trim-down the output

Voltage of 5.0V model (MHB150-48S05)

by 8% to 4.6V,  $R_{Trim-down}$  is

calculated as follows :

$$V_{o,nom} - V_o = 5.0 - 4.6 = 0.4 V$$

$$R1 = 5.8 \text{ Kohm}$$

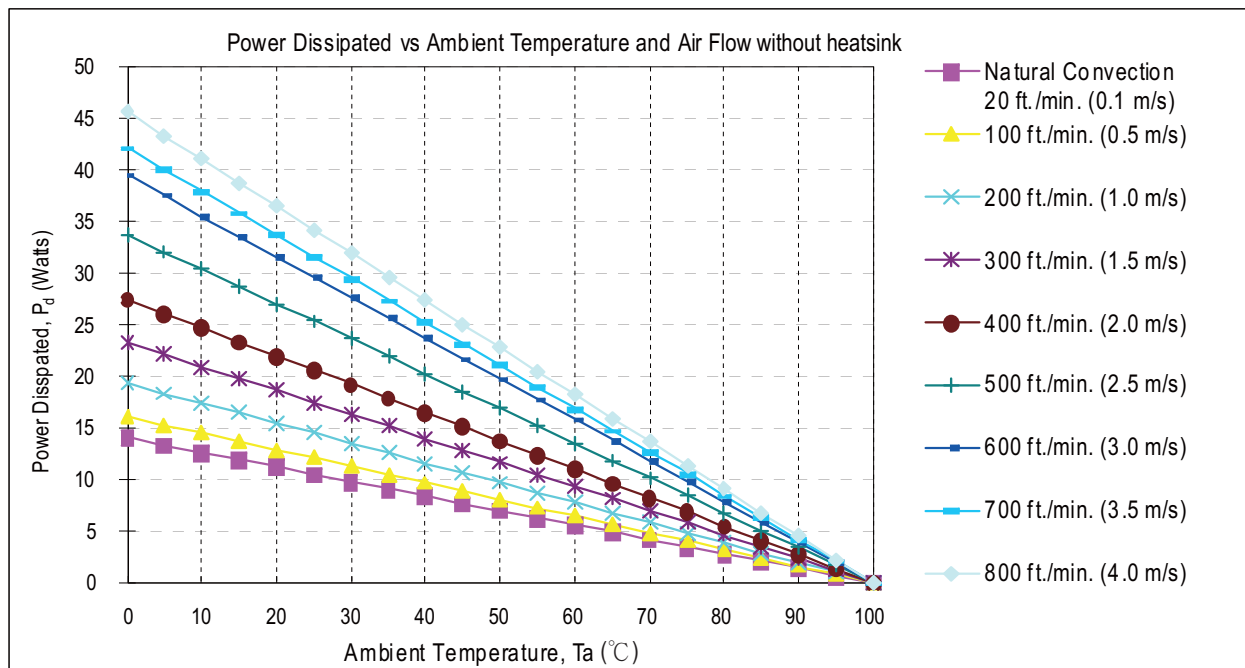
$$R2 = 5.32 \text{ Kohm}$$

$$R_{Trim-down} = \frac{5.8 - 5.32 \times 0.4}{0.4} = 9.18 (K\Omega)$$

### Thermal Curve

The operating case temperature range of MHB-150 series is -40°C to +100°C. When operate the MHB-150 series, proper de-rating or cooling is needed.

The maximum case temperature under any operating condition should not be exceed 100°C. The following curve is the de-rating curve of MHB-150 series without heat sink.



| Air Flow Rate                             | Typical Rca | Air Flow Rate         | Typical Rca |
|-------------------------------------------|-------------|-----------------------|-------------|
| Natural convection<br>20ft./min. (0.1m/s) | 7.12°C/W    | 500 ft./min. (2.5m/s) | 2.96°C/W    |
| 100 ft./min. (0.5m/s)                     | 6.21°C/W    | 600 ft./min. (3.0m/s) | 2.53°C/W    |
| 200 ft./min. (1.0m/s)                     | 5.17°C/W    | 700 ft./min. (3.5m/s) | 2.37°C/W    |
| 300 ft./min. (1.5m/s)                     | 4.29°C/W    | 800 ft./min. (4.0m/s) | 2.19°C/W    |
| 400 ft./min. (2.0m/s)                     | 3.64°C/W    |                       |             |

Rca : Thermal resistance from case to ambience

Example:

What is the minimum airflow necessary for a MHB150-48S12 operates at nominal line, an output current of 12.5A, and a maximum ambient temperature of 40°C?

Solution:

Given:  $V_{in}=48V_{dc}$ ,  $V_o=12V_{dc}$ ,  $I_o=12.5A$ ,  $\eta$  (unit efficiency)=89%

Determine Power dissipation ( $P_d$ ):

$$P_d = P_i - P_o = P_o(1 - \eta) / \eta$$

$$P_d = 12 \times 12.5 \times (1 - 0.89) / 0.89 = 18.54 \text{ Watts}$$

Determine airflow:

Given:  $P_d=18.54W$  and  $T_a=40^\circ C$

Check Thermal Curve above:

minimum airflow= 500 ft./min.

Verifying: The maximum temperature rise  $\Delta T = P_d \times R_{ca} = 18.54 \times 2.96 = 54.88^\circ C$

The maximum case temperature  $T_c = T_a + \Delta T = 94.88^\circ C < 100^\circ C$

Where: The Rca is thermal resistance from case to ambience.

The Ta is ambient temperature and the Tc is case temperature.

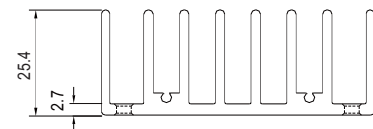
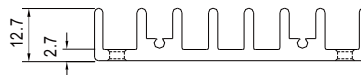
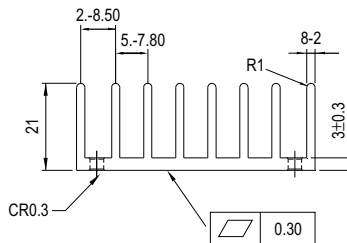
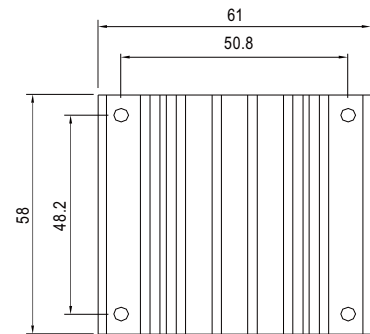
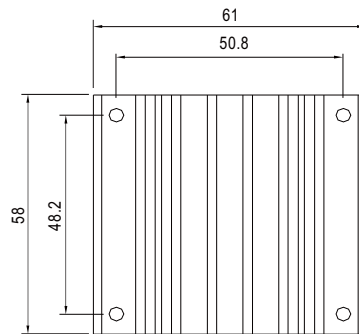
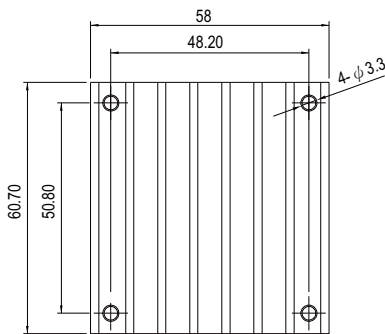
### ■ Case Heat Sink (Optional)

Unit:mm

Model No.: M-C308 (Vertical Fins)

Model No.: M-C091(Horizontal Fins)

Model No.: M-C092 (Horizontal Fins)



#### Rca:

$3.90^{\circ}\text{C/W}$  (typ.), at natural convection  
 $1.74^{\circ}\text{C/W}$  (typ.), at 100ft./min.(LFM)  
 $1.33^{\circ}\text{C/W}$  (typ.), at 200ft./min.(LFM)  
 $1.12^{\circ}\text{C/W}$  (typ.), at 300ft./min.(LFM)  
 $0.97^{\circ}\text{C/W}$  (typ.), at 400ft./min.(LFM)

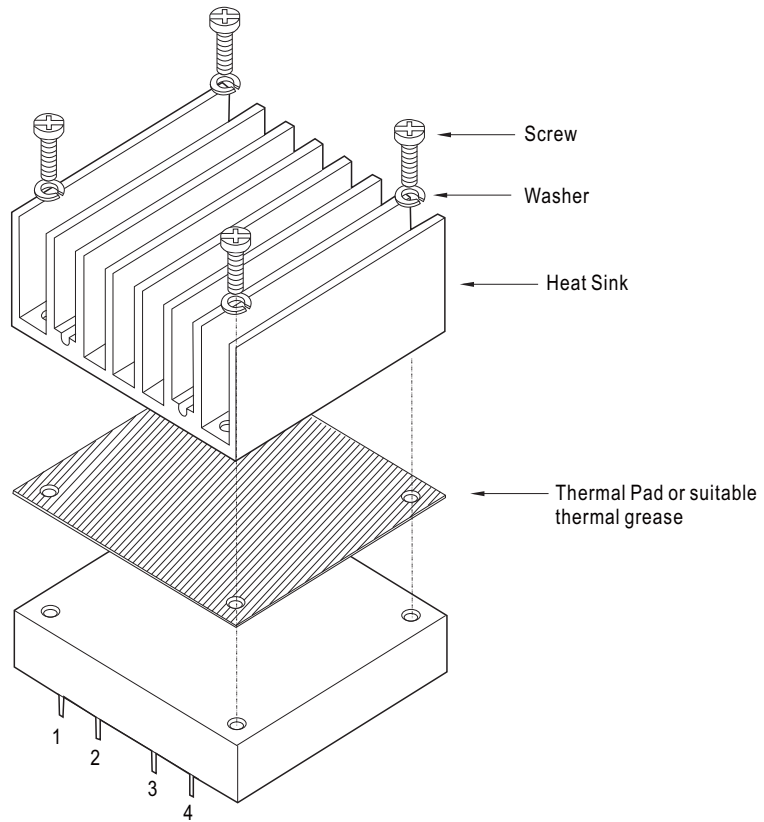
#### Rca:

$4.70^{\circ}\text{C/W}$  (typ.), at natural convection  
 $2.89^{\circ}\text{C/W}$  (typ.), at 100ft./min.(LFM)  
 $2.30^{\circ}\text{C/W}$  (typ.), at 200ft./min.(LFM)  
 $1.88^{\circ}\text{C/W}$  (typ.), at 300ft./min.(LFM)  
 $1.59^{\circ}\text{C/W}$  (typ.), at 400ft./min.(LFM)

#### Rca:

$3.00^{\circ}\text{C/W}$  (typ.), at natural convection  
 $1.44^{\circ}\text{C/W}$  (typ.), at 100ft./min.(LFM)  
 $1.17^{\circ}\text{C/W}$  (typ.), at 200ft./min.(LFM)  
 $1.04^{\circ}\text{C/W}$  (typ.), at 300ft./min.(LFM)  
 $0.95^{\circ}\text{C/W}$  (typ.), at 400ft./min.(LFM)

### Heatsink Assembly



Heat Sink Order No.:

M-C308

M-C091

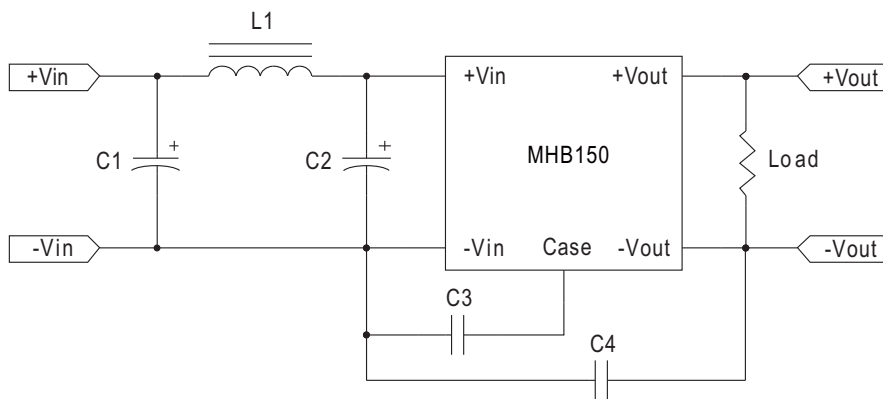
M-C092

Thermal Pad: 56.9x60x0.25mm

Screw: SMP+SW M3x8L

### EMC Suggestion Circuit

※Required external components to meet EN55022 class A conducted emission are as below:



| Model No.   | C1                     | C2                     | C3     | C4     | L1    |
|-------------|------------------------|------------------------|--------|--------|-------|
| MHB150-48S□ | 47uF/100V<br>ESR<0.17Ω | 47uF/100V<br>ESR<0.17Ω | 1000pF | 1000pF | 3.4uH |

□ =05,12,24